

Five-Year Review Document
for the
Naval Reactors Facility
OU 8-08 Sites

June 2004

By

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1.0 Introduction

Bechtel Bettis Incorporated (BBI) operates the Naval Reactors Facility (NRF) for the U. S. Department of Energy (DOE), Office of Naval Reactors. In 1991, DOE signed a Federal Facilities Agreement and Consent Order (FFA/CO) with the Idaho Department of Health and Welfare, (IDHW) and the U. S. Environment Protection Agency (EPA) Region 10, which initiated NRF's participation in the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) at the Idaho National Engineering and Environmental Laboratory (INEEL).

BBI, on behalf of the signatories of the FFA/CO, has conducted a Five-Year Review of the remedial actions implemented for twelve No Further Action (NFA) sites and nine Operable Unit (OU) 8-08 Remedial Action (RA) sites at NRF. The purpose of the Five-Year Review is to determine whether completed remedies remain protective of human health and the environment. For sites where the remedy is incomplete, the focus of the review will be to determine if the remedy is being constructed in accordance with the requirements of the decision documents and design specifications, and if the remedy is expected to be protective when it is completed.

A Five-Year Review is required if the selected remedial actions result (or will result) in any hazardous substances, pollutants, or contaminants remaining at the site above levels that would allow for unlimited use and unrestricted exposure, and the Record of Decision (ROD) for the site was signed on or after October 17, 1986. These conditions apply to the NRF OU 8-08 sites; therefore, a statutory Five-Year review was conducted at NRF.

This is the first Five-Year Review for the NRF OU 8-08 NFA sites and RA sites. This review covers twelve NFA sites designated as NRF-02, NRF-16, NRF-18A, NRF-22, NRF-23, NRF-42, NRF-43, NRF-61, NRF-66, NRF-81, NRF-82, and NRF-83. The NRF OU 8-08 RA sites included NRF-11, NRF-12A, NRF-12B, NRF-14, NRF-17, NRF-19, NRF-21A, NRF-21B, and NRF-80. Figure 1 depicts the location of these sites at NRF. The trigger for this statutory review is the date when the remedial action began with excavation at NRF-14, which was June 25, 1999.

- LEGEND
- (NRF-7) NRF WELL
- (USGS 102) USGS WELL

REMEDIAL ACTION AREAS

11. S1W TILE DRAINFIELD & L-SHAPED SUMP [8-08-11]
- 12A. UNDERGROUND PIPING TO LEACHING PIT [8-08-12A]
- 12B. S1W LEACHING PIT [8-08-12B]
14. S1W LEACHING BEDS [8-08-14]
17. S1W RETENTION BASINS [8-08-17]
19. A1W LEACHING BED [8-08-19]
- 21A. OLD SEWAGE BASIN [8-08-21A]
- 21B. SLUDGE DRYING BED [8-08-21B]
80. A1W/S1W RADIOACTIVE LINE NEAR BUTLER BUILDING 19 [8-08-80]

NO FURTHER ACTION AREAS

2. OLD DITCH SURGE POND
16. RADIOGRAPHY BUILDING COLLECTION TANKS
- 18A. S1W SPRAY POND #1 & PORTIONS OF FIRE PROTECTION SYSTEM [8-03-18A]
22. A1W PAINTING LOCKER FRENCH DRAIN [8-03-22] REMOVAL ACTION PERFORMED
23. SEWAGE LAGOONS [8-03-23]
42. OLD SEWAGE EFFLUENT PONDS [8-02-42]
43. SEEPAGE BASIN PUMPOUT AREA [8-08-43]
61. OLD RADIOACTIVE MATERIALS STORAGE & LAYDOWN AREA [8-02-61]
66. HOT STORAGE PIT [8-08-66]
81. A1W PROCESSING BUILDING AREA SOIL [8-08-81]
82. EVAPORATOR BOTTOMS TANK RELEASE [NRF-82]
83. ECF HOT CELLS RELEASE AREA [NRF-83]

● (NRF-13) (Actual location of this well is 340 feet further north)

● (NRF-7)



0 125 250 375 500
Scale in Feet

■ (USGS 87) (Actual location of this area is approximately 2,300 feet further south)

Figure 1 Location of No Further Action and Remedial Action Sites

2.0 Site Chronology

Table 1 summarizes the chronology of significant events for the NRF OU 8-08 sites. This list includes construction dates and key regulatory dates.

Table 1 Site Chronology	
Date	Event
November 1989	NPL ¹ listing (Entire INEEL)
September 1998	Record of Decision signed
June 1999	Work at NRF-14 commences – Time line for 5 Year-Review begins
September 1999	Phase I RD/RA Work Plan issued
July 2002	Explanation of Significant Difference (to the Record of Decision) to add a third engineered cover was signed)
August 2002	Phase II RD/RA Work Plan issued
June 2003	Phase I work completed
April 2004	Construction of Engineered Covers begins
June 2004	Five-Year Review Report issued
October 2004	Phase II Engineered Cover construction completed (planned schedule)
October 2005	Phase II Engineered Cover construction completed (enforceable schedule)

¹ NPL - National Priorities List (list of sites requiring evaluation under CERCLA)

3.0 Background and Physical Characteristics

3.1 Site Location and Demography

3.1.1 Idaho National Engineering and Environmental Laboratory

The INEEL is a government facility managed by the DOE, located 32 miles west of Idaho Falls, Idaho. This site occupies 894 square miles (mi²) of the northeastern portion of the Eastern Snake River Plain. Facilities at the INEEL are primarily dedicated to environmental research, nuclear research and development, and waste management.

3.1.2 Naval Reactors Facility

NRF is located on the west central side of the INEEL, as shown on Figure 2, approximately 50 miles west of Idaho Falls, Idaho. NRF was established in 1949 as a testing site for the Naval Nuclear Propulsion Program. The Westinghouse Electric Company operated NRF for DOE, Office of Naval Reactors from 1949 through the fall of 1998, at which time site operations were turned over to BBI. NRF covers 7 square miles, of which 80 acres are developed. At various times, the site was occupied by up to 3,300 people. Approximately 750 BBI employees and 190 long-term subcontractor and DOE employees are currently working at NRF. The nearest public roads to NRF are approximately 7 miles west, 10 miles north, and 10 miles south.

3.2 Site Physical Characteristics

The INEEL is located on the northeastern portion of the Eastern Snake River Plain, a volcanic plateau that is composed primarily of volcanic rocks and relatively minor amounts of sediments. Underlying the INEEL is a series of basaltic flows containing sedimentary interbeds. The Snake River Plain Aquifer (SRPA) is the largest potable aquifer in Idaho, and underlies the Eastern Snake River Plain and the INEEL. The aquifer is approximately 200 miles long and 50 miles wide, and covers an area of approximately 9,600 mi². The depth to the SRPA at the INEEL varies from approximately 200 feet in the northeastern corner to approximately 900 feet in the southeastern corner. The distance between these extremes is 42 miles. The depth to groundwater beneath NRF is approximately 370 feet.

The INEEL is located in a temperate climate, with warm summers and cold winters. Average daily temperatures range from 7 °F during the winter to 70 °F during the summer. Temperature extremes range from -47 °F to 105 °F. NRF receives approximately 9 inches of precipitation per year.

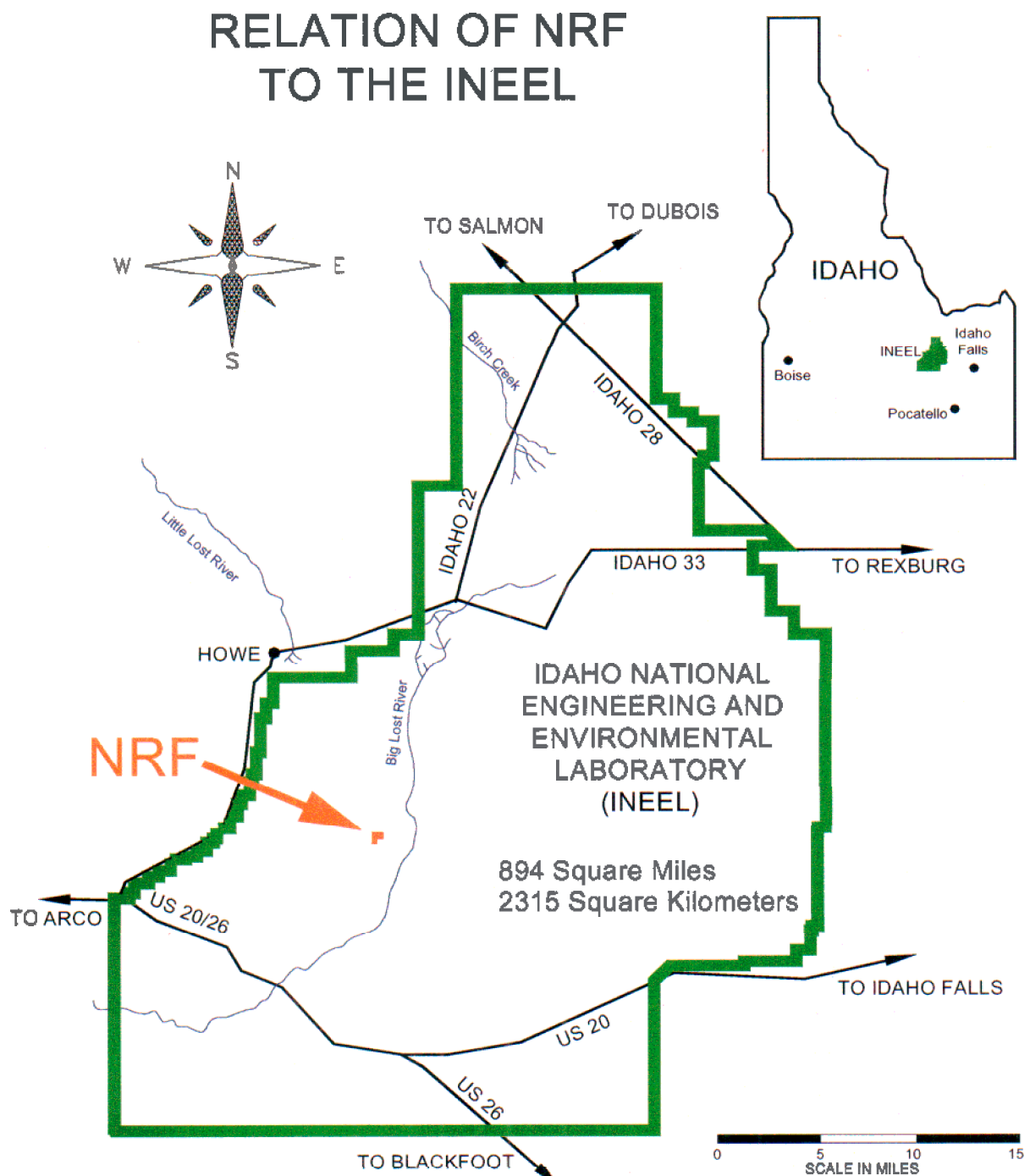


Figure 2 Location of the Naval Reactors Facility (Waste Area Group 8)

3.3 Land Use and Resource

3.3.1 Past and Current Land Use

The INEEL was established in 1949 as the National Reactor Testing Station by the United States Atomic Energy Commission as a site for building, testing, and operating nuclear reactors, fuel processing plants, and support facilities with maximum safety and isolation. In 1974, the area was designated as the Idaho National Engineering Laboratory to reflect the broad scope of engineering activities conducted there. The name was changed to the INEEL in 1997 to reflect the redirection of its mission to include environmental research.

The Bureau of Land Management manages the surrounding areas for multipurpose use. Communities nearest to the INEEL are Atomic City (south), Arco (west), Butte City (west), Howe (northwest), Mud Lake (northeast), and Terreton (northeast). In the counties surrounding the INEEL, approximately 45% is agricultural land, 45% is open land, and 10% is urban. Fences and security personnel strictly control public access to facilities at the INEEL. A total of 90 miles of paved highways pass through the INEEL and are used by the public.

NRF consists of three former Naval nuclear reactor prototype plants, the Expended Core Facility (ECF), and miscellaneous support buildings. Construction of the Submarine Thermal Reactor Prototype (S1W) at NRF began in 1951. The prototype completed operation in 1989. The Large Ship Reactor Prototype (A1W) was constructed in 1958 and completed operation in January 1994. The Submarine Reactor Plant Prototype (S5G) was constructed in 1965 and completed operation in May 1995. The prototypes were used to train sailors for the nuclear Navy and were used for research and development purposes. The Expended Core Facility, which receives, inspects, and conducts research on Naval nuclear fuel, was constructed in 1958 and is still in operation. The Dry Storage Overpack Facility was completed in 2001 to store expended Naval nuclear fuel in a non-aqueous environment.

3.3.2 Projected Land Uses

Land use is a consideration when determining the appropriate level of risks within an area of concern. NRF is projected to continue operations at ECF until at least 2035. Operations will continue to include receiving, inspecting, and conducting research on Naval nuclear fuel, as well as the temporary dry storage of Naval nuclear fuel until a permanent national repository is available. Other NRF operations will include the decontamination and disposition actions associated with retired buildings and facilities. The INEEL future land use document states that the most likely land use scenario for the area around NRF will be industrial for the next 100 years (approximately until 2095), and residential use is assumed following this one hundred year period.

3.4 History of Site Contamination and Basis for Response

The OU 8-08 sites include areas where past controlled releases of low-level radioactive water were discharged as part of facility operations and areas where inadvertent releases to the environment occurred because of leaks from corroded piping, leaks in underground concrete basins, surface releases, and cross-contamination of non-radiological systems with radiological systems. A Comprehensive Remedial Investigation/Feasibility Study (RI/FS) covering the OU 8-08 sites was performed in 1997.

Several different risk assessments were performed for the Comprehensive RI/FS to evaluate the potential human health and environmental risks posed by the identified sites at NRF. Track 1 and Track 2 investigations were performed for OUs 8-01, 02, 03, 04, and 09 prior to the NRF Comprehensive RI/FS (these are part of a screening process that could progress into a full RI/FS based on the outcome of the risk assessment performed under these investigations). The following risk assessments were performed as part of the NRF Comprehensive RI/FS: risk assessments for individual OU 8-08 sites not previously investigated, a cumulative risk assessment of all NRF sites, and an ecological risk assessment. The OU 8-08 site assessments evaluated the human health risk associated with contaminants present at each site. The cumulative risk assessment evaluated the potential cumulative, or additive, human health risks for receptors based on their proximity to multiple sites and potential for exposure from more than one site at a time. The ecological risk assessment evaluated the potential risk to ecological receptors. Those sites that contain or potentially contain one or more contaminants of concern (COCs) above the target risk range are identified as sites of concern or Remedial Action (RA) sites. The following presents a summary of the different risk assessments (including key elements such as scenarios, exposure pathways, etc.) discussed above and performed at NRF for the OU 8-08 sites.

The human health risk assessment for the individual OU 8-08 sites assessed in the NRF Comprehensive RI/FS evaluated residential and occupational scenarios. For the residential scenario, assessments were made for a receptor residing at the site 30 years and 100 years in the future. The residential scenario assumes that a residence would be constructed with a 10-foot basement. The future residential scenario assumes the site remains under Federal Government control for at least 30 or 100 years. A current and 30-year occupational scenario was also evaluated. The occupational scenario assumes that no controls are in place to prevent exposure to COCs.

Cobalt-60 was one of the primary COCs for the occupational scenarios. However, with a half-life of approximately five years, cobalt-60 will have decayed to insignificant amounts within 100 years which would be the earliest a residence at NRF (from the assumption of 100 years of industrial control) could be expected. Most of the sites that show an elevated risk are subsurface soil contaminated areas. Therefore excavation would be required before exposure to contaminants could occur. The typical occupational receptor at NRF would rarely visit these sites (i.e., annual environmental monitoring and sampling) and limited work activities performed there would not require any excavation. Based on the preceding information, the 100-year residential scenario is the scenario of concern for the OU 8-08 sites.

Soil ingestion, inhalation of fugitive dust, and external radiation exposure are the potential exposure pathways considered for the occupational and residential scenarios for the individual OU 8-08 sites. In addition, the groundwater ingestion and food crop ingestion pathways were considered only for the residential scenario since these two pathways were not a concern for the occupational scenario. The dermal absorption pathway was qualitatively evaluated for the residential scenario.

The groundwater exposure pathway was evaluated using computer modeling and groundwater sampling data. For the contaminants identified as COCs, the GWSCREEN computer modeling program did not show them reaching the groundwater during the 100-year residential scenario for the individual OU 8-08 sites. These sites do not have a current water source to drive contaminants toward the groundwater. GWSCREEN is conservative in that it underestimates the amount of time for contaminants to reach the aquifer; even so, many of the radiological contaminants were shown to decay to below risk-based concentrations prior to reaching the

aquifer. A review of the groundwater sampling data showed that some elevated levels of contaminants have been detected during sampling. However, none of the average concentrations of contaminants were found to be above the stringent maximum contaminant levels (MCLs) of Federal drinking water standards. These MCLs are based on allowable risk levels established by the EPA. Computer modeling and groundwater sampling show the groundwater pathway is not a pathway of concern at NRF.

An individual site risk assessment was performed under the Track 1 type investigation for the No Further Action sites NRF-18A, NRF-22, NRF-42, NRF-61, NRF-82, and NRF-83. The risk to human health and the environment associated with these sites was determined to be low. The remaining No Further Action sites (NRF-2, NRF-16, NRF-23, NRF-43, NRF-66, and NRF-81) were assessed during the Comprehensive RI/FS. Based on the INEEL future land use, the access controls NRF has imposed on these sites, and the fact that contaminants are located in the subsurface, the 100-year future residential scenario was applicable for the remedial actions taken. All sites possessed a carcinogenic risk that was between one in a million ($1E-06$) and one in ten thousand ($1E-04$). Such risks did not warrant active remedial actions.

The following RA sites were assessed during the Comprehensive RI/FS: NRF-11, NRF-12A, NRF-12B, NRF-14, NRF-19, NRF-21A, NRF-21B, and NRF-80. A risk assessment was not performed for lead, which was detected at one location (NRF-12B) above EPA recommended screening levels for lead cleanup. Lead was retained as a COC. A risk assessment was not performed for NRF-17 (the S1W Retention Basins) due to the difficulties involved in sampling below the basins (while they were still intact) in the suspected area of contamination. However, soil sampling performed at downstream sites from the basins within the same disposal system showed an unacceptable risk for cesium-137 and strontium-90 to a potential 100-year future resident. It is also known that one of the basins leaked on at least one occasion and the leakage was capable of contaminating soils below the basins. Therefore, a presumptive decision was made that some of the soils beneath the retention basins were contaminated with cesium-137 and strontium-90 at concentrations which exceed risk-based levels. Similarly, a presumptive decision was also made that some of the soils within NRF-11 and NRF-80 contained contaminants (cesium-137 at both sites, and strontium-90 at NRF-80) above risk-based levels because of the uncertainties when sampling these sites (sampling conducted at these sites may not have been fully representative of site conditions), because of the potential for leakage within these sites, and because sampling results from other discharge units associated with these sites indicated contaminants existed above risk-based levels. Thus, NRF-11, NRF-17, and NRF-80 were retained as sites of concern or RA sites.

A Screening Level Ecological Risk Assessment (SLERA) evaluated the known or potential sites at NRF where previous investigations and sampling had determined that a source of contamination remained. Risks were calculated for six representative wildlife species based on an INEEL guidance manual for performing SLERAs. The constituents were evaluated through the ingestion and external exposure pathways. Assessment results were used to compare risks. The risks associated with the exposures to the ecological receptors are characterized as low. Although there are uncertainties associated with this screening assessment, the results indicate that no additional actions are required due to estimated risks to ecological receptors.

In addition to the individual site assessment, a cumulative risk assessment was performed to determine if there are additional risks due to the cumulative or additive effects associated with having several individual sites near one another. The 100 year future occupational worker and 100-year future resident were the scenarios considered for the cumulative risk assessment. The same exposure pathways were considered as in the individual site assessment with the

exception of soil ingestion and food crop ingestion pathways because they are not likely to occur from more than one release site at a time.

Of the nine contaminants of concern identified in the ROD, only three of these contaminants were detected above risk-based concentrations. These three primary contaminants of concern were lead, cesium-137, and strontium-90. Therefore, the ROD stated that remediating the soil below these three specific contaminant concentrations would reduce the risk associated with those constituents and in all likelihood would reduce the other six contaminants' risk values.

Generally, CERCLA cleanup decisions are based on carcinogenic excess risk levels slightly greater than 1 chance in 10,000 (1E-04) where excess risk is the possibility of contracting cancer above the national average. The target risk range for CERCLA sites is between 1E-04 and 1E-06 and represents an upper and lower risk level where a remedial action may be required. A remedial action is likely at risk levels greater than 1E-04. A risk less than 1E-06 is usually considered acceptable and allows for unlimited use and unrestricted exposure. A risk management decision on whether a remedial action is appropriate is made by the agencies when the calculated risk is between 1E-04 and 1E-06. Because of the conservative nature of the risk assessment assumptions used to calculate a corresponding soil concentration, a risk management decision was made to use the 1 in 10,000 excess carcinogenic risk as the target risk for calculating risk-based soil concentrations.

Remedial Action Objectives (RAOs) established an exposure route maximum cumulative risk of 1E-4. Remediation goals, which generally refer to a specific contaminant concentration (corresponding to a 1E-4 excess carcinogenic risk with the exception of lead which reflects a corresponding soil concentration that is an EPA recommended screening level for lead cleanup), were established to meet the RAOs and are based on lead, cesium-137, and strontium-90 concentrations. The remediation goals for OU 8-08 are 16.7 picocuries per gram (pCi/g) of cesium-137, 45.6 pCi/g of strontium-90, and 400 parts per million (ppm) lead. The remediation goals are based on human health risks and are also protective to ecological receptors. As stated previously, the ecological risk assessment concluded no additional action above those actions taken for protection of human health was necessary due to estimated risks to ecological receptors. In addition, for the soils that were left in place at the remediation levels for cesium-137 and strontium-90, these constituents are expected to radioactively decay (based on the constituents' half-life) to acceptable risk levels at the end of the 100-year institutional control period.

A Record of Decision (ROD) was signed in 1998 for the OU 8-08 sites. Twelve sites were determined to be 'No Further Action' (NFA) and nine sites were determined to be 'Remedial Action' (RA) sites.

The NFA designation is made by the agencies for those sites with a source or potential source present, but for which an exposure route is not available. The remedial action for these sites is Institutional Controls (ICs). These NFA sites should not be confused with the 'No Action' decision which means no future evaluations or follow-ups are required.

The ROD defines RA sites as sites where contamination or the potential for contamination exist at levels that pose an unacceptable exposure risk and actions to mitigate this risk are required. The nine radiological sites were included in screening, development, and detailed analysis for remedial action alternatives and resulted in the selection of "Limited Excavation, Disposal, and Containment."

3.4.1 No Further Action Sites

These sites have been managed through the use of ICs and periodic reviews via annual Institutional Control Monitoring Reports (ICMRs) (Bechtel 2001, 2002, and 2003), and Five-Year Reviews (current and future). The ICMRs indicate that aside from several minor findings (missing signs and loose fence stands), conditions at the No Further Action sites have not changed; therefore, the risk posed by these sites remains within acceptable limits. The following list discusses each of the No Further Action sites individually.

NRF-02 Old Ditch Surge Pond - This site was originally a gravel or soil pit. In 1959 the pit was connected to the NRF interior waste ditch system and a pond area formed. The pond and connecting ditch were used from approximately 1959 to 1985. Low-levels of radioactivity and slightly elevated levels of metals were detected in the pond. The pond became contaminated with very low levels of radioactivity when water with trace amounts of cobalt-60 and cesium-137 was released to the ditch in the late 1960s. Accumulation of radioactivity in the upper several feet of ditch sediments produced slightly elevated levels that are below remediation goals.

NRF-16 Radiography Building Collection Tanks - The building was originally a decontamination building used for cleaning radioactive equipment. The decontamination solutions were sent to two underground tanks. These tanks were used from 1954 to 1960. Adjacent to the building was a concrete pad that was used for outdoor storage of radioactive material. The concrete pad was removed in 1979. The tanks were removed in 1993 with no indication of leakage. Sampling results showed arsenic (which was found at depth adjacent to the underground tanks), cesium-137, cobalt-60, and uranium-235 above risk based screening levels; however, the risk assessment performed for this site was very conservative and a risk management decision was made that the actual risks are acceptable.

NRF-18A S1W Spray Pond #1 - The S1W Spray Pond #1 is a large concrete structure that contained cooling water for plant operations. At one time, a chromium based corrosion inhibitor was used in the water. Leakage and overspray from the pond caused an elevated chromium concentration in the surrounding soil. A risk assessment showed a low risk for this site assuming the Spray Pond remains in place, thus limiting exposure to the soil below the basins in the event that any contamination is present.

NRF-22 A1W Painting Locker French Drain - This site is the location of a former French drain that may have received paints, solvents, and possibly mercury. A removal action was performed in 1994 after receiving public comment on the proposed action. Sampling performed after the removal action showed elevated levels of lead and mercury remained. The excavated hole was 12 feet deep and was grouted to the surface eliminating all exposure pathways. The risk assessment of the site after the removal action estimated the risk to be low.

NRF-23 Sewage Lagoons - This site is the current sewage lagoons. The lagoons are two open rectangular ponds that measure 425 feet by 725 feet each. The northeast lagoon is currently active, while the southwest lagoon is typically dry and receives overflow from the active lagoon on occasion. Both lagoons are lined with clay. The sewage lagoons were built in 1960 and expanded to their current length in 1972. The lagoons were designed to be evaporative ponds; however, subsurface seepage of liquid effluent from the active lagoon has created a shallow perched water zone beneath the pond. This water contains non-hazardous cations and anions. Sampling of the sediment has shown the presence of slightly elevated levels of metals and radionuclides and only trace amounts of organics in the upper 12 inches of soil. Most contaminants are believed to be contained within the lagoon sludge or lagoon clay lining. The

risk assessment performed for this site was very conservative and a risk management decision was made that the actual risks are acceptable.

NRF-42 Old Sewage Effluent Ponds - This site is the location of a former temporary sewage pond used in the 1950s. There is no evidence that a hazardous source exists at the site, but elevated amounts of metals, semi-volatile organics, and low-level radionuclide contaminants may be present based on sampling performed in the current sewage lagoons. The site is currently covered with a 10 foot layer of soil. Based on current conditions (i.e., 10 foot soil cover), the risk was estimated to be low.

NRF-43 Seepage Basin Pump-out Area - This site is an area that physically surrounds NRF-21A and was formed when the contents of NRF-21A (Old Sewage Basin) were pumped out into the surrounding area in 1958. The effluent to NRF-21A had been cross-contaminated with radioactivity in 1956. The cross-contaminated effluent was transferred to NRF-43. During the spring and summer of 2002, in conjunction with remediation of NRF-21A, the amount of contaminated soil and the size of NRF-21A were discovered to be much larger than anticipated. A portion of NRF-21A extended into the previously identified NRF-43 area. NRF and the regulatory agencies decided that NRF-21A, including the extended portion into NRF-43, would be capped with an earthen cover similar in design to those slated for NRF-12/14 and NRF-19. This decision was documented in an Explanation of Significant Difference (ESD) issued in 2002. Construction of the cover was initiated in 2004.

NRF-61 Old Radioactive Materials Storage and Laydown Area - This site is the historic location of a radioactive material storage and laydown area that was used from 1954 to 1960. Soil sampling showed detectable amounts of cesium-137 that were well below remediation levels. The risk was determined to be low.

NRF-66 Hot Storage Pit - This site is an area where a tanker truck collected radioactive liquid waste for transportation to other INEEL facilities for processing. Spills reportedly occurred in this area. Contaminated soil was removed from the area in 1980. Sampling during the remedial investigation showed slightly elevated amounts of cesium-137 that were well below remediation levels.

NRF-81 A1W Processing Building Area Soil - This site is an area around a radioactive materials processing building where known spills have occurred in the past. Typically, these spills were cleaned up to the maximum extent possible at the time. Cesium-137 and cobalt-60 were the only radionuclides detected during past sampling, and both were below remediation levels.

NRF-82 Evaporator Bottoms Tank Release - This site consists of the soil above an underground storage tank vault. One spill was known to have occurred at the area in 1972. The spill was cleaned up to the standards at the time, but slightly elevated amounts of radioactivity were reported after the cleanup. Additional cleanup was performed in 1977. The remaining radioactivity is below remediation levels.

NRF-83 ECF Hot Cells Release Area - NRF-83 is located within an operational building (Expended Core Facility) and is adjacent to hot cells that are currently in use. Radioactive liquid was released in 1972 from a pipe to a concrete trench. The soil below and adjacent to the trench also became contaminated. Cleanup actions taken in 1972 did not include the soil below the trench. The contaminated soil was discovered in 1997 when a concrete pad adjacent to the concrete trench was removed during ECF upgrade work. Elevated amounts of cobalt-60 and

cesium-137 are present in the soil. All accessible contaminated soil was removed and replaced with clean soil during the construction project. Twenty eight cubic meters of contaminated soil is estimated to remain under the trench to preserve the integrity of the trench. A new concrete pad was poured at the location of the old concrete pad excavation. The contaminated soil below the trench is not presently accessible and no exposure route is available.

3.4.2 OU 8-08 Remedial Action Sites

Nine sites were determined in the NRF Comprehensive RI/FS (WEC 1998) to have unacceptable or potentially unacceptable risks that must be addressed. The radionuclides of concern were cesium-137 and strontium-90, both of which have a 30-year half-life. Since Phase II remedial activities are not complete (i.e., earthen covers will be built over NRF-12B/14, NRF-19, and NRF-21A), a comprehensive discussion on risk reduction at the OU 8-08 RA sites will not be presented at this time. The following list discusses each of the OU 8-08 RA Sites individually.

NRF-11 S1W Tile Drainfield and L-Shaped Sump - This site consisted of a below-surface concrete L-shaped sump and four underground perforated drainfield pipes of various lengths downstream of the sump. The drainfield was likely used between 1953 and 1955 for sewage and radioactive liquid discharges. The drainfield area was approximately 36 feet wide by 150 feet long and consisted of four perforated pipes buried parallel to each other approximately eleven feet deep. Each outside leg of the drainfield extended about 150 feet, while both inner legs were 50 feet long. The drainfield was connected to the sump, which was an L-shaped concrete structure. Each leg of the sump was 11 feet long and three feet wide with a maximum depth of 12-1/2 feet. The sump was isolated from the drainfield in 1955, but was used until 1960 as part of the sewage system. The primary remedial action associated with this site was excavation of piping, concrete, and soil above remediation goals.

NRF-12A Underground Piping Leading to Leaching Pit - This site consisted of an underground pipe (465 feet) that ran from the S1W Retention Basins (NRF-17) to a subsurface concrete manhole. This pipe is known to have leaked on occasion. From the manhole, a perforated pipe used for draining and leaching purposes ran approximately 400 feet to the S1W Leaching Pit (NRF-12B) at a depth of approximately 8 to 10 feet. This site was used from 1955 through 1961 for radioactive liquid discharges. The primary remedial actions associated with this site were excavation of piping, removal of soil above remediation goals and removal of the manhole.

NRF-12B S1W Leaching Pit - This site consists of a former pit area that was used for radioactive discharges. The pit was constructed at the end of the drainfield piping (NRF-12A) in 1957 and was used until 1961. The pit was filled in with soil, and in 1978 an asphalt cap was placed over the pit. In preparation for construction of an earthen cover, the asphalt cap was demolished and removed during the summer of 2003. The primary remedial action associated with this site is the construction of an engineered cover over the area, which will include site NRF-14 discussed below.

NRF-14 S1W Leaching Beds - This site consists of two leaching beds, one constructed in 1960 and the other in 1963. These beds were open ponds that collected radioactive water and allowed the water to leach into the subsurface or evaporate. Each bed was about 75 feet by 125 feet at the water line and was 13 to 15 feet deep. The ponds were used until 1979. Large cobblestones were placed in the leaching beds in 1972. Earthen ramps were constructed to allow sampling equipment into the beds in 1992. This site includes the underground pipe

leading to the leaching beds from the S1W Retention Basins (NRF-17). The primary remedial actions associated with this site were the excavation of the pipe leading to the beds, consolidation of soil from other CERCLA sites in the beds, and construction of an engineered cover over the area.

NRF-17 S1W Retention Basins - This site consisted of two concrete basins partially below grade that collected radioactive water from various facilities. This was a storage area prior to releasing the water to NRF-11, NRF-12A/12B, and NRF-14. The basins were constructed in 1951. The basins were two adjacent concrete structures, each 140 feet long by 34 feet wide. One of the basins was known to have leaked approximately 33,000 gallons in 1971. The leak was directly below the basins. The remedial actions associated with this site were the removal of the concrete structures and excavation of contaminated soil above remediation levels.

NRF-19 A1W Leaching Bed - This site consisted of an underground leaching bed. Perforated pipes ran through an engineered leaching bed that consisted of various layers of gravel and sand. The bed was constructed west of NRF in 1957, and was used continually from 1958 to 1964 and sporadically between 1964 and 1972. The bed was 200 feet long and 50 feet wide. Two underground pipes led to the leaching bed. The remedial actions associated with this site were the excavation of the pipes leading to the bed and any associated contaminated soil and the construction of an engineered cover over the area.

NRF-21A Old Sewage Basin - This site consists of a former open pond used for non-radiological discharges that was cross-contaminated from a radiological system. An unknown amount of radioactive effluent was sent to the sewage basin. The sewage basin was constructed in 1956 and measured 72 feet by 72 feet by 11 feet deep. A 10-inch concrete pipe led to the sewage basin from the L-shaped sump (part of NRF-11). The basin was enlarged in 1957 in the southeast direction to approximately double the original length and was used until 1960. The basin has since been filled in with soil. The remedial actions associated with this site were the excavation of piping and the contaminated soil that was above remediation levels. After a portion of the piping and contaminated soil had been excavated, it was determined that contaminated soil above the remediation level extended significantly into the expanded portion of the basin. In July 2002, an Explanation of Significant Difference was signed by Naval Reactors Idaho Branch Office (IBO), the State of Idaho, and the EPA, and issued to the public to modify the preferred remedy to include construction of an engineered natural earthen cover over the original and expanded area.

NRF-21B Sludge Drying Bed - This site consisted of a concrete bed that received sludge from the sewage system. It was cross-contaminated from a radiological system. The bed was constructed in 1951 as part of the sewage system at NRF. The bed was a concrete slab that was 28 feet by 29 feet and was approximately five feet below grade. The primary remedial actions associated with this site were the excavation of concrete and soil above remediation levels.

NRF-80 A1W/S1W Radioactive Line Near BB19 - This area consisted of an underground pipe that was known to have leaked near the S1W Spray Pond. The pipe carried radioactive water for eventual discharge to the S1W Leaching Beds (NRF-14). The pipe was buried approximately six feet below the surface. During decontamination and disposition work at NRF in 1995, portions of the pipe were removed and contamination was detected in the soil. The primary remedial actions associated with this site were the excavation of piping and contaminated soil above remediation levels.

4.0 Remedial Actions

4.1 Remedy Selection

A No Further Action decision was made by the DOE, the State of Idaho, and the EPA for those sites with a source or potential source present, but for which an exposure route is not available under current conditions. This No Further Action decision means that the site will be included in a CERCLA review performed at least every five years to ensure that site conditions used to evaluate the site have not changed and to verify the effectiveness of the No Further Action decision. This remedy selection did not require any additional remedial action other than ICs such as signs and fencing, administrative controls on excavation, and inspections. Institutional controls are discussed in more detail in Appendix D (Institutional Control Plan) of the Phase II Work Plan, and in the annual ICMRs.

The ROD-selected remedy for the remedial action sites is "Limited Excavation, Disposal, and Containment." This remedy was divided into two phases to expedite the remedial action process. The Phase I Remedial Design/Remedial Action (RD/RA) Work Plan activities included excavation of contaminated soil above cleanup levels, relocation of contaminated soil from other RA Sites to NRF-12B/14, removal and characterization of piping and concrete fixtures for disposal off-site (away from NRF), and backfilling with clean soil. The Phase II RD/RA Work Plan activities included construction of engineered covers over the filled S1W leaching beds (NRF-12B/14) and A1W leaching bed (NRF-19). In 2002, the selected remedy for site NRF-21A was modified per an ESD to the ROD to include construction of an engineered cover over NRF-21A and most of Seepage Basin Pump out Area (NRF-43). Institutional Controls, to prevent unauthorized intrusion and excavation and to control land use and transfer, will be included as part of the selected remedy for the RA sites. These actions address human health risk posed by the RA sites and are also assumed to address ecological risk. In addition to engineered earthen covers, the selected remedy at NRF-12B/14, NRF-19, and NRF-21A also included installation of soil moisture probes.

To protect human health and the environment, Remedial Action Objectives (RAOs) for the RA Sites were developed and documented in the ROD. These RAOs are discussed below:

Human Health:

- Prevent external gamma radiation exposure from all radionuclides of concern that exceed a total exposure pathway excess cancer risk of 1 in 10,000 for the future 100-year residential receptor.
- Prevent ingestion of soil and food crops contaminated with radionuclides of concern that exceed a total pathway excess cancer risk of 1 in 10,000 for the future 100-year residential receptor.
- Prevent exposure to soil contaminated with lead that exceeds the EPA recommended screening level of 400 ppm for lead cleanup.

Environmental:

- Prevent erosion or intrusion by resident plant or animal species in contaminated soils that could cause the release of contaminated soils.
- Prevent exposure to COCs that may cause adverse effects on resident species populations.

4.2 Remedy Implementation

The primary RA implemented at the NFA sites is ICs. All NFA sites have been or will be posted with signs that indicate site identification, site hazard, access restrictions and a point of contact. Sites NRF-16, NRF-23, NRF-61, NRF-66, and NRF-81 are enclosed within fences. The remaining sites are either outside the NRF site fence (thus away from the general NRF population) or are beneath structures (resulting in limited access). All sites are inspected at least annually followed by the issuance of an ICMR containing the results of the inspections.

The Phase I and Phase II Remedial Design Report and Remedial Action Work Plans for Operable Unit 8-08, as approved by the State of Idaho and EPA, provided the design criteria for the selected remedies. Remedy implementation was designed to proceed in two phases as discussed above.

Phase I remedial actions began at NRF-14 on June 25, 1999 and were completed in June 2003, and involved excavation at eight of the nine sites (all except NRF-12B) that had or potentially had risk levels that exceeded 1 in 10,000. These remedial actions resulted in the removal of contaminated soil above remedial goals from the surface to at least 10 feet below ground surface. Some contaminated soil and/or piping was left in place at NRF-14 and NRF-19 at locations that will be beneath the earthen covers when they are constructed. Contaminated soil was relocated to NRF-14 and NRF-12B area (S1W Leaching Bed/Pits).

During the Phase I remedial action activities, which included excavation of contaminated soil and pipe removal at NRF-14, PCB Aroclor-1242 was detected at some sample locations (see Figure 3), below the ten foot depth. However, the results at these locations were still below the minimum low occupancy cleanup level (10 ppm). The levels detected within an area of approximately 20 ft x 30 ft ranged between 1 ppm to less than 10 ppm. These levels were detected in soil that is below the 10-foot depth, which was the target depth for cleanup actions associated with the Phase I RAs.

Various levels of ICs have been implemented at the remediation sites. These included signs limiting access and temporary barriers. Other measures that have been used during site Phase I RAs to limit exposure to contaminants included dust suppression and placing clean soil and tarps over contaminated areas. The spread of contamination was also curtailed during Phase I operations at NRF-17, most of NRF-12A, and a small part of NRF-14 by conducting the RAs within large tents.

Phase II work, which includes construction of the earthen covers (at NRF-12B/14, NRF-19, and NRF-21A) and installation of soil moisture probes, began in April 2004 and is scheduled for completion in October 2004, which is nearly 12 months ahead of the required completion date of October 2005.

Contaminated soil that was removed during Phase I RAs was placed into soft-sided containers and transported to the S1W Leaching Beds areas. As portions of the leaching beds were filled, the area was covered with soil and compacted. Water was used for both dust suppression and to aid with compaction. Current work on the soil cap includes placement of a bio-layer (6 inch diameter cobble), and a gravel and clay layer. Dust suppression measures are also being implemented. Access roads leading to the construction areas are marked with temporary warning signs to prohibit unauthorized entry. Table 2 below summarizes the progress of the remedial actions to date.

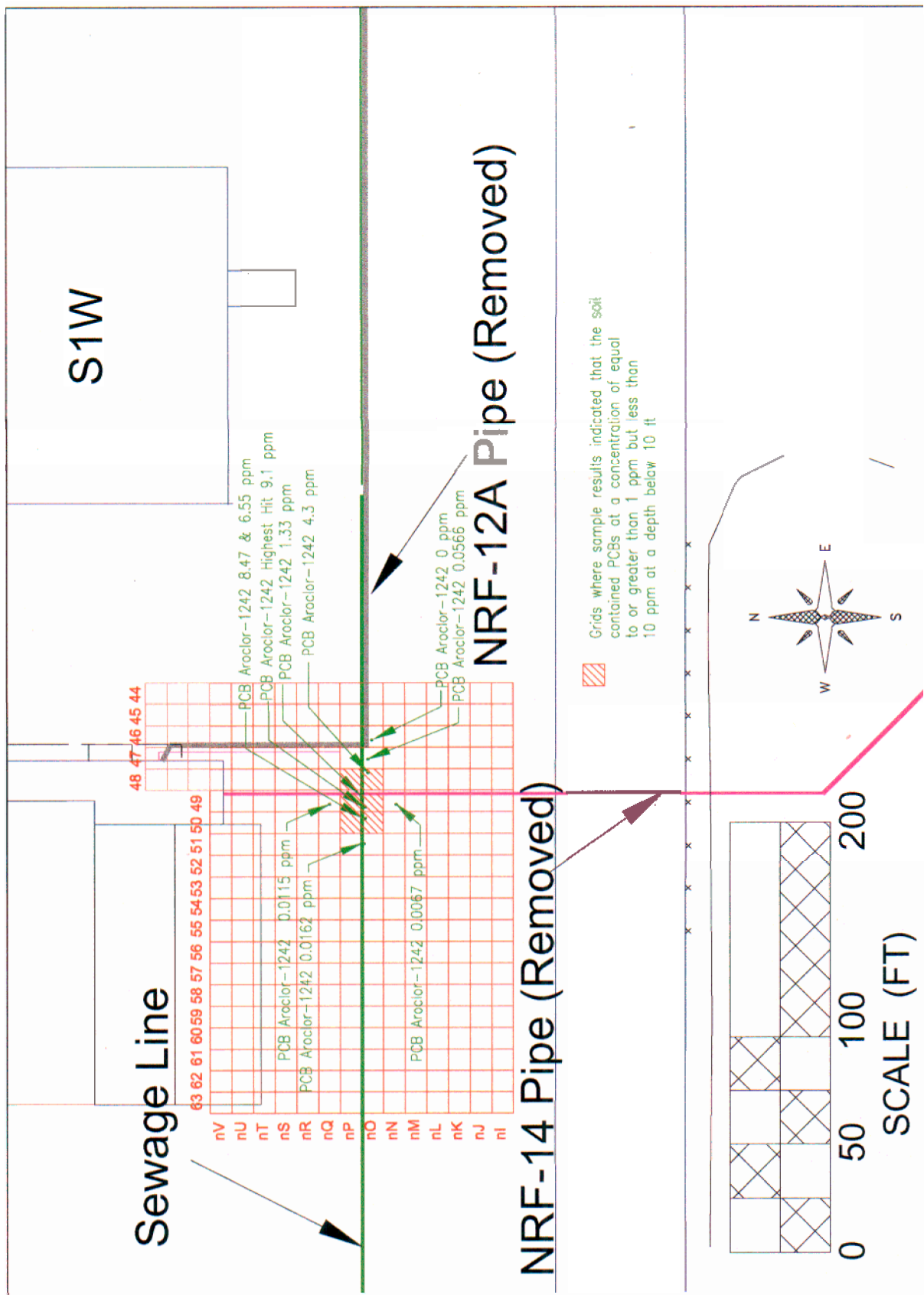


Figure 3 Grids where PCB was detected

Table 2 Summary Data for Selected OU 8-08 5-Year Review Report

SITE	Feet of Pipe Removed	Volume of Soil Removed	Volume of Concrete Removed	Work Completed to Date	Work to be Completed
NRF-11 (Including L-Shaped Sump)	488' 6"	120 yd ³	21 yd ³	All soil and pipe removed	ICs
NRF-12A (Including Concrete Manhole)	824' 8"	5505 yd ³	2.6 yd ³	All soil and pipe removed	ICs
NRF-12B/14	NA	NA	N/A	Asphalt cap removed (400 yds ³)	Construct cover, ICs
NRF-14 (supply line)	530'	165 yd ³	N/A	All soil and pipe removed	ICs
NRF-17	N/A	1120 yd ³	1,875 yd ³	Soil beneath concrete and concrete removed	ICs
NRF-19	200'	86 yd ³	N/A	All soil and pipe removed	Construct cover, ICs
NRF-21A	435'	890 yd ³	N/A	Partially removed soil	Construct cover, ICs
NRF-21B (Sludge Drying Bed)	N/A	60 yd ³	19 yd ³	All soil and concrete removed	ICs
NRF-80	93'	4 yd ³	N/A	All soil and pipe removed	ICs
TOTALS	2571' 2"	7,950 yd³	1,917.6 yd³		

ICs = Institutional Controls

5.0 Five-Year Review Findings

5.1 Five-Year Review Process

The format of the NRF Five-Year Review Document is patterned after the June 2001 EPA guidance document for Five-Year Reviews and the March 2002 DOE Review Guide. As such, this section of the Five-Year Review Document discusses past inspections of the No Further Action Sites, data, and ARARs. Bechtel Bettis, Inc (BBI) personnel have reviewed past site information, including sampling data, ICMRs, work plans, and RODs, and were responsible for drafting this Five-Year review. DOE Idaho Branch Office (IBO), EPA, and Idaho Department of Environmental Quality personnel have also reviewed this information and approved this report.

The main goals of this Five year review were to determine whether the selected remedies remain protective of human health and the environment, and where remedies are not yet complete, to ensure that the remedy is being constructed in accordance with the requirements of the decision documents and design specifications. This document is available at the INEEL Information Repository. Public notification of the Five-Year review and its availability will be given in local newspapers.

5.2 No Further Action Site Inspections

NRF issued its initial ICMR in 2001 and annual ICMRs in 2002 and 2003. Each ICMR included site inspections of the No Further Action sites. No significant deficiencies were noted during site inspections.

5.3 Data Review

NRF has been collecting groundwater data from its monitoring network since 1989. As part of the Five-Year Review for NRF Landfill Areas conducted in 2001, a comprehensive review and analysis the groundwater data was performed. The 2001 Five-Year Review concluded that the NRF Groundwater Monitoring Well Network adequately monitors the Snake River Plain Aquifer near NRF. Both local and regional downgradient groundwater quality data indicate no significant impact from NRF (i.e., the landfill areas, the Industrial Waste Ditch, and the RA sites). The upcoming Remedial Action Report is expected to show that groundwater data collected since the 2001 Five-Year Review have consistently verified this conclusion.

5.4 Review ARARs

The selected remedy of containment with an engineered earthen cover for three RA areas was designed to meet substantive aspects of the Applicable or Relevant, and Appropriate Requirements (ARARs) identified in the ROD. The following are the pertinent ARARs that were defined for the selected remedies and that were reviewed for changes that could affect protectiveness:

- 40 CFR 61.92, NESHAPS for Emissions of Radionuclides Other than Radon, (Applicable)
- IDAPA 16.01.01.585 & .586, Toxic Substances, (Applicable to work where potential release of these substances exists)
- IDAPA 16.01.11.200.01(a), Idaho Groundwater Quality Rule, (Relevant and Appropriate)
- IDAPA 16.01.05.006.01(40 CFR 262.1), Hazardous Waste Determination, (Applicable to work generating hazardous waste)
- IDAPA 16.01.05.005 (40 CFR 261), Identification and Listing of Hazardous Waste, (Applicable to work generating hazardous waste)
- IDAPA 16.01.05.011 (40 CFR 268.7, .9, .40, .45, .48) Land Disposal Restrictions, (Applicable to work generating hazardous waste)
- IDAPA 16.01.01.651, Idaho Fugitive Dust Emissions, (Applicable)

- IDAPA 16.01.05.008 (40 CFR 264.309(a), 40 CFR 264.310(a)(1)(2)(3)(4)(5), and .310.(b)(1)(4)(5)(6)), Standards for Owners and Operators of Hazardous Waste Treatment, Storage and Disposal Facilities (Surveying, Closure, and Post Closure Care for Landfills), Relevant and Appropriate
- 40 CFR 300.440 Procedures for Planning and Implementing Off-site Response Actions (Applicable to work that involves off-site transfer of CERCLA waste)
- 16 USC 470 National Historic Preservation, (Applicable to any site where cultural, historical artifacts are found)

These ARARs have not become more stringent since the signing of the ROD.

6.0 Assessment

In the EPA Comprehensive Review Guidance for Five-Year Reviews, the EPA provided three questions to aid in assessing remedy performance. These questions and their answers are summarized in Table 3.

Table 3 Answers to Guidance Questions			
Questions:	Answers:		
	No Further Action Sites	Remedial Action Sites	
A: Is the remedy functioning as intended by the decision documents?	Data reviews and site inspections indicate that the remedies are functioning as intended.	NRF-11 NRF-12A NRF-17 NRF-21B NRF-80	These remedies were performed in accordance with the Phase I Work Plan. Relevant data and ARARs to be presented in the upcoming Remedial Action report are expected to show that the remedies are functioning as intended, and thus protective of human health and the environment.
		NRF-12B NRF-14 NRF-19 NRF-21A	These remedies are being performed in accordance with the Phase II Work Plan. A review of the relevant data and ARARs to be presented in the upcoming Remedial Action Report are expected to show that the remedy was constructed in accordance with the requirements of the Remedial Design, and that the remedy is protective of human health and the environment.
B: Are the exposure assumptions, toxicity data, cleanup levels, and remedial action objectives (RAOs) used at the time of the remedy still valid?	Yes	NRF-11 NRF-12A NRF-17 NRF-21B NRF-80	Yes
		NRF-12B NRF-14 NRF-19 NRF-21A	Upon completing the engineered covers, it appears that the answer will be yes.
C: Has any other information come to light that could call into question the protectiveness of the remedy?	No	No	No

6.1 Remedy Performance

6.1.1 No Further Action Sites

The primary remedy selected for the No Further Action sites is Institutional Controls (ICs). These controls are intended to prevent unauthorized intrusion and excavation and to control land use and transfer. Annual inspections are performed to insure that conditions at the sites remain the same and to insure that ICs are effective. As discussed in Section 5.2, inspections confirm that the remedy is performing as intended.

6.1.2 Remedial Action Sites

Contaminated soil, piping, and concrete have been removed from NRF-11, NRF-12A, NRF-14 (soil and pipe leading to the S1W Leaching Bed), NRF-17, NRF-19 (soil and pipe leading to the A1W Leaching Bed), NRF-21A (soil and pipe leading to the old sewage basin), NRF-21B, and NRF-80. Small quantities of slightly contaminated soil (> 1 pCi/g but < 16.7 pCi/g cesium-137) meeting the cleanup criteria were left in the ground at most sites.

Soil above the cleanup level (> 16.7 pCi/g cesium-137) at below the 10 foot depth was left only at the NRF-12A site, in a few areas; this action was consistent with the ROD. Figure 4 shows the locations of these remaining areas. Data to be presented in the Remedial Action Report is expected to show that soil removal met the RAOs, thus the risk associated with these sites is expected to be at acceptable levels. The Remedial Action Report has an enforceable submittal date 60 days after completion of the final site inspection. The final site inspection is planned for fall of 2005. NRF and the DOE do not anticipate that NRF will be subject to leasing or property transfer through the year 2095. This was the basis of the cleanup levels stipulated in the ROD. Consistent with CERCLA, NRF/DOE will indicate the presence of contamination and any restrictions in property transfer documentation that may occur after 2095.

The selected remedies for the NRF-12B/14 (S1W Leaching Bed/Pit), NRF-19 (A1W Leaching Bed), and NRF-21A (Old Sewage Basin) are yet to be completed. The cover construction activities are scheduled for completion in October 2004. Work will proceed as specified in the Phase II Work Plan.

Groundwater data to be presented in the Remedial Action Report are expected to show that OU 8-08 COCs have not been detected above the Federal Maximum Contaminant Levels.

Observations presented in the upcoming Remedial Action Report are expected to show that the remedy was constructed in accordance with the requirements of the Remedial Design, and is protective of human health and the environment.

7.0 Deficiencies

7.1 No Further Action Sites

Inspections indicate that there are no significant deficiencies associated with the selected remedies for the No Further Action Sites.

7.2 Remedial Action Sites

Remedial actions at the RA sites are not fully implemented; however, the data to be presented in the upcoming Remedial Action Report is expected to show that the remedy was constructed in accordance with the requirements of the Work Plan, and is protective of human health and the environment.

8.0 Recommendations and Required Actions

NRF is in the process of writing a Remedial Action Report for the Remedial Action Sites. The draft of this report is required to be submitted to the EPA 60 days after completion of the OU 8-08 final inspection, which is currently expected to occur in fall of 2005. The RA report will discuss the remedial actions in detail, including meeting RAOs, risk reduction, and expected effectiveness of the remedial actions. In addition, the second Five-Year review for the OU 8-05/06 NRF Inactive Landfill Areas is scheduled to be submitted by February 26, 2006. NRF may combine the next five year review for the OU 8-08 sites with that required for the OU 8-05/06 Inactive Landfill Areas, for clarity and efficiency.

9.0 Conclusions

9.1 No Further Action Sites

From the information gathered, the selected remedies for the No Further Action sites appear to be effective at limiting unauthorized access and excavation. Furthermore, data indicate that activities at NRF have not adversely affected the groundwater, thereby supporting the No Further Action designation of the sites. The selected remedies remain protective of human health and the environment.

9.2 Remedial Action Sites

It is expected that all evidence presented in the upcoming Remedial Action Report will indicate that the selected remedies, i.e., soil, concrete and pipe removal, and consolidation of contaminated soil at NRF-12B/14, have been successful in achieving RAOs. Therefore, the remedy at OU 8-08 is expected to be protective of human health and the environment upon completion, and in the interim, exposure pathways that could result in unacceptable risks are being controlled. The construction of three earthen covers, coupled with implementation of institutional controls, will complete NRF remedial actions as outlined in the Phase I and II Work Plans.

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